IOWA HIGHWAY RESEARCH BOARD (IHRB)
Minutes of October 25, 2013

Regular Board Members Present

A. Abu-Hawash
S. Okerlund
R. Knoche
R. Kieffer
D. Schnoebelen
W. Weiss
D. Miller
K. Mayberry
E. Steffensmeier
R. Fangmann
T. Wipf

Alternate Board Members Present

D. Sprengeler for R. Younie
P. Mouw for P. Assman

Members with No Representation

K. Jones

Secretary - M. Dunn

Visitors

Donna Buchwald	Iowa Department of Transportation
Linda Narigon	Iowa Department of Transportation
Leighton Christiansen	Iowa Department of Transportation
Ken Dunker	Iowa Department of Transportation
Jan Laaser-Webb	Iowa Department of Transportation
John Dostart	Iowa Department of Transportation
Michael Kennerly	Iowa Department of Transportation
Brent Phares	Iowa State University
Keith Knapp	Iowa State University

The meeting was held at the Iowa Department of Transportation Ames Complex, Materials East/West Conference Room, on Friday, October 25, 2013. The meeting was called to order at 9:00 a.m. by Chairperson Ahmad Abu-Hawash with an initial number of 13 voting members/alternates at the table.

July Minutes
Motion to approve Minutes from the September 27, 2013 meeting

Motion to Approve by 1st E. Steffensmeier 2nd K. Mayberry
Motion carried with 13 Aye, 0 Nay, 0 Abstaining.

ANNUAL REPORT and PROPOSAL for Continuation of funding HR-296, *"Iowa Local Technical Assistance Program (LTAP)",* Keith Knapp, ISU/InTrans, ($145,000)

BACKGROUND

The Iowa LTAP began in 1983 as the Rural Technical Assistance Program (RTAP). It was one of 10 original RTAPs funded by the Federal Highway Administration (FHWA) in 10 states. These programs were typically called technology transfer centers, or T2 centers. The goal of the Iowa RTAP was to share new research and information with local transportation agencies and help them in their daily transportation operations. The Iowa RTAP outreach efforts—including a quarterly technology newsletter, transportation lending library, training workshops, and individualized technical assistance—helped prove the benefits of such a program and RTAP was eventually funded in all 50 states, Puerto Rico, and seven tribal regions. In 1991, the national RTAP was renamed the Local Technical Assistance Program (LTAP) and also incorporated the Tribal Technical Assistance Program (TTAP). This change included the addition of an urban element to the program.

The Iowa LTAP is managed through the Institute for Transportation (InTrans) at Iowa State University under an annual contract administered by the Iowa Department of Transportation (Iowa DOT). Funding for the Iowa LTAP and its related activities primarily comes from the FHWA and the IHRB. Additional funding to support Iowa LTAP staff and their activities is also acquired through individual state and federal project contracts, Iowa State University Extension, non-profit organizations, and the Iowa Governor's Traffic Safety Bureau. Other sources of funding also continue to be explored.

OBJECTIVES

The primary objective of Iowa LTAP is to provide quality training events and technical transportation-related information that is useful to local transportation agencies. These activities need to be completed, within current LTAP funding, in a manner that is effective and efficient. Desirably, these activities are also provided when they are most needed by local transportation agencies and in a format that is useful and useable. New knowledge and tools, developed through IHRB research or other entities (e.g., the Institute for Transportation (InTrans)), are incorporated, as appropriate, into either existing or new LTAP activities.

The strategic planning and decision-making needed to make Iowa LTAP a premier technology transfer resource is guided by the following principles:

- Define and respond to customer needs;
- Provide quality customer service through various methods;
- Evaluate effort and track performance to improve service and communicate impacts;
- Apply fiscal responsibility through the selection of economically feasible and sustainable activities/tasks;
- Strive for predictable program funding and continue with highly capable staff;
- Expand and strengthen state and national organizational partnerships that may enhance Services

Motion to Approve by 1st W. Weiss, 2nd P. Mouw
Motion carried with 13 Aye, 0 Nay, 0 Abstaining.

FINAL REPORT, TR-636, *"Bridge Damage Detection: Integration of Structural Health Monitoring System Concepts and components – A Statewide Collaboration",* Brent Phares, ISU/InTrans, ($303,433)

BACKGROUND

Although bridge testing has been an important tool for evaluating structures for several decades, it has only been within the last decade that specific effort has been given to develop systems that are capable of operating in an autonomous fashion. The development of an automatic and low-cost structural health monitoring (SHM) system is in high demand and crucial to reduce the costs associated with manual inspection, effectively monitor the status of bridges, and, therefore, minimize risk associated with bridge infrastructure.

The Iowa State University Bridge Engineering Center (BEC) began a project in 2002 (through the Federal Highway Administration Innovative Bridge Research and Construction program) to evaluate the state's first bridge constructed with high-performance steel. One of the objectives was to further the state's expertise in long-term bridge monitoring.

This project was the first major, concerted effort to handle large amounts of performance data. A great deal was learned during this project. Principally, an algorithm was developed that allowed for the automated removal of temperature effects, which represented a significant step in the development of a long-term monitoring system.

The Iowa Department of Transportation (DOT) started investing in research (through both the Iowa Highway Research Board and the Office of Bridges and Structures) in 2003 to develop an SHM system capable of identifying damage and able to report on the general operational condition of bridges.

In some cases, the precipitous has been a desire to avoid damage that might go unnoticed until the next biennial inspection. Of specific and immediate concern was the state's inventory of fracture-critical structures.

OBJECTIVES

Through collaboration, the goal of this project was to bring together various components of the completed research at Iowa's Regent Universities with the following specific objectives:

• Final development of the overall SHM system hardware and software
• Integration of vibration-based measurements into current damage-detection algorithms
• Evaluation and development of energy-harvesting techniques suitable for wireless sensor networks

DISCUSSION

Q. Is there any opportunity to try the remote sensors on some of our projects?
A. Yes, the bridges that we are monitoring are a great opportunity since we have internet connectivity.

Q. With everyone looking at this comprehensive study as far as the energy harvesting approach is this a viable solution long-term?
A. Currently it is the only viable solution. The only renewable energy options available are solar and wind. Wind is not always available, so it is unreliable. Solar panels are still relatively

inexpensive for small amounts of power. We had hoped to use a vibration based sensor to generate the power, but the throughput just wasn't there. Until there is more fundamental research we have no choice using the energy harvesting approach.

Q. On the false positive do you think the weak link is the strain gage and that it deteriorates over time?
A. It is all in the sensitivity at the strain gage. If we ran the same truck across the bridge 100 times we would get variations in the strain of +/- 5. We are right at that level of sensitivity with this approach where a few microstrain makes a difference. If we could better characterize the distribution of those errors and use them to reduce the uncertainty, we could reduce the false positives.

Motion to Approve by 1st R. Knoche, 2nd D. Schnoebelen
Motion carried with 13 Aye, 0 Nay, 0 Abstaining.

FINAL REPORT, TR-612, *"Wind Loads on Dynamic Message Cabinets and Behavior of Supporting Trusses",* Ashgar Bhatti, University of Iowa, ($218,498)

BACKGROUND

Typical overhead truss structures in Iowa have been made of aluminum alloy with fillet-welded tube-to-tube connections. Aluminum, favored for its light weight and corrosive resistance, however, has much lower fatigue resistance than structural steel. Welding heat reduces the strength of the material based on factors such as welding speed and cooling rate. Moreover, welding of typical aluminum alloy used at overhead truss structures in Iowa removes heat treatment near the welds and thus reduces aluminum properties locally. Geometric discontinuities at tube-to-tube connections also generate significant stress concentrations. The welded connections therefore have high risks of cracks. According to the Action Plan of DMS Trusses from Iowa DOT, 36 trusses were erected from 1993 to 2006 and in 2007 cracks were found in 14 of 19 (74%) inspected DMS trusses. Figure 1 shows typical crack locations on a truss structure. It was found that most cracks occurred at the diagonal members while a few of them occurred on vertical members.

In addition, an evaluation conducted by Purdue University for one of cracked truss structures indicated that the cracks seemed to be brittle fractures caused by extreme loads. A detailed examination of the cracks is shown in Fig. 2. Figure 2a shows that failure occurred at the welding material, which then progressed through the entire weld throat. The diagonal and chord members were also found not to be completely merged. The crack in Fig. 2b occurred near the welding toe and propagated into the base material. In order to predict the behavior of a highway overhead truss structure, detailed understanding of the loads and the 8 response of the structure are necessary. The influences of temperature variation and wind on the structure will be examined in this study.
Structural supports for overhead signs vary by materials and design specifications. There are three main types of designs: cantilever, bridge, and butterfly. The truss structures discussed in the study are typical bridge-type truss structures, which are designed with a large span to carry heavy signs.

OBJECTIVES

The objectives of this study are to investigate wind and thermal effects on the bridge type overhead trusses supporting Dynamic Message Sign (DMS) cabinets. The goal is to understand the behavior causing cracking in some truss members and to improve current design specifications and methods.

Motion to Approve by 1st T. Wipf, 2nd R. Fangmann
Motion carried with 13 Aye, 0 Nay, 0 Abstaining.

NEW BUSINESS

George Constantinescu, University of Iowa, presented a project idea to the Board for comment and input - **Investigation of the historic 1993 and 2008 flood over-toppings on bridge abutments and development of design guidelines for scour protection measures**

The main objective of this project is to improve the current guidelines for protection measures against adverse flood-overtopping effects (e.g., severe scour) at bridge abutments at a time when flood frequency and intensities are continuously increasing. In the case of bridges with erodible abutments (such small bridges are very common in Iowa especially in rural areas), riprap stone is commonly used to protect the side slope surface of abutments against erosion (e.g., the sheet piles underneath the toe of an abutment can become exposed to the flow). In most of these cases, the abutments are protected by placing a riprap apron of unequal height around the base of the two abutments.

There was a discussion on the need for the project and some feedback was given by the Board. No formal request was made to the Board.

ADJOURN

Motion to Approve by 1st R. Knoche, 2nd D. Schnoebelen
Motion carried with 13 Aye, 0 Nay, 0 Abstaining.

The next meeting of the Iowa Highway Research Board will be held Thursday, December 12, 2013, at InTrans. The meeting will begin promptly at 1:00 p.m.

Mark J. Dunn

Mark J. Dunn, IHRB Secretary